Comprehensive Energy Audit
For
Kwigillingok Washeteria

Prepared For

Native Village of Kwigillingok

August 24, 2016

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PREFACE

This energy audit was conducted using funds provided by the United States Department of Agriculture as part of the Rural Alaskan Village Grant (RAVG) program. Coordination with the Native Village of Kwigillingok has been undertaken to provide maximum accuracy in identifying audits and coordinating potential follow up retrofit activities.

The Rural Energy Initiative at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Native Village of Kwigillingok, Alaska. The authors of this report are Bailey Gamble, Mechanical Engineer I; and Kevin Ulrich, Assistant Engineering Project Manager and Energy Manager in Training (EMIT).

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in May of 2016 by the Rural Energy Initiative of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Water Treatment Plant Operator John Carter, Native Village of Kwigillingok Tribal Administrator Andrew Beaver and Tribal Finance Officer Richard John, and Kwig Power Company representative Diane Atti.

1. EXECUTIVE SUMMARY

This report was prepared for the Native Village of Kwigillingok. The scope of the audit focused on Kwigillingok Washeteria. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, heating and ventilation systems, and plug loads.

Based on electricity and fuel oil prices in effect at the time of the audit, the total predicted energy costs are $37,288 per year. Fuel represents the largest portion with an annual cost of approximately $20,893. Electricity represents the remaining portion, with an annual cost of approximately $16,394. This includes about $9,787 paid by the village and about $6,607 paid by the Power Cost Equalization (PCE) program through the State of Alaska.

The State of Alaska PCE program provides a subsidy to rural communities across the state to lower electricity costs and make energy affordable in rural Alaska. In Kwigillingok, the cost of electricity without PCE is $0.67/kWh and the cost of electricity with PCE is $0.40/kWh.

There is a heat recovery system that supplies recovered heat from the power plant to meet the majority of the heating demand in the Water Treatment Plant. Extending this heat recovery system over to the Washeteria could save the village an additional 3,000 gallons of fuel per year ($13,950 per year at current fuel prices) on top of the proposed retrofit savings.

An energy audit report was also developed for the Kwigillingok Water Treatment Plant. This report compliments the Washeteria energy audit. This report will be distributed separately from the Kwigillingok Washeteria report.

Table 1.1 lists the total usage of electricity and #1 heating oil in the Kwigillingok Washeteria before and after the proposed retrofits.

Table 1.1: Predicted Annual Fuel Use for the Washeteria

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	24,469 kWh	21,984 kWh
#1 Oil	4,493 gallons	3,626 gallons

Benchmark figures facilitate comparing energy use between different buildings. Table 1.2 lists several benchmarks for the audited building. More details can be found in section 3.2.2.

Table 1.2: Building Benchmarks for the Washeteria

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	411.3	31.66	$22.67
With Proposed Retrofits	336.6	25.91	$19.20
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

Table 1.3 below summarizes the energy efficiency measures analyzed for the Kwigillingok Washeteria. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.3: Summary of Recommended Energy Efficiency Measures

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
1	Setback Thermostat: Washeteria	Implement a heating setback of 60 deg F in the Washeteria during unoccupied hours.	$1,353	$200	90.74	0.1	6,226.1
2	Ventilation	Clean dryer lint traps regularly so that dryers don't have to run as long and plenum vent doesn't have to run as often.	$777	$500	20.04	0.6	3,724.0
3	Lighting - Power Retrofit: Front Office Lights	Replace with new energy-efficient LED lighting.	$124	$160	9.06	1.3	646.3
4	Lighting - Power Retrofit: Main Room Lights	Replace with new energy-efficient LED lighting.	$494	$640	9.06	1.3	2,585.0
5	Generic Clothes Drying Load	Replace broken solenoid valves with Belimo valves to improve dryer efficiency and reduce electrical consumption and run time.	$1,533	$3,000	6.73	2.0	7,194.7
6	Lighting - Power Retrofit: Entryway Light	Replace with new energy-efficient LED lighting.	$23	$60	4.53	2.6	121.5

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
7	Heating Ventilation, and Domestic Hot Water (DHW)	Clean boilers, replace hi-lo limits controllers, install larger expansion tank to address boiler #3 expansion issues, reprogram Tekmar boiler controller.	$1,039 + $200 Maint. Savings	$8,000	2.63	6.5	4,719.3
8	Lighting - Combined Retrofit: Boiler Room Lights	Replace with new energy-efficient LED lighting, replace manual switching with occupancy sensor.	$205	$980	2.46	4.8	1,071.2
9	Lighting - Power Retrofit: Bathroom 1 Light 1	Replace with new energy-efficient LED lighting.	$4	$20	2.39	4.9	21.4
10	Lighting - Power Retrofit: Bathroom 1 Light 2	Replace with new energy-efficient LED lighting	$8	$40	2.39	4.9	42.7
11	Lighting - Power Retrofit: Bathroom 2 Light 2	Replace with new energy-efficient LED lighting	$4	$20	2.39	4.9	21.4
12	Lighting - Power Retrofit: Bathroom 2 Light 1	Replace with new energy-efficient LED lighting	$8	$40	2.39	4.9	42.7
13	Lighting - Power Retrofit: Bathroom 1 Light 3	Replace with new energy-efficient LED lighting	$8	$40	2.30	5.1	41.0
14	Lighting - Power Retrofit: Storage Room Lights	Replace with new energy-efficient LED lighting	$23	$120	2.22	5.2	120.3
15	Air Tightening	Perform air sealing to reduce air leakage by 5%.	$97	$500	1.78	5.2	444.2
16	Lighting - Power Retrofit: Mop Room Lights	Replace with new energy-efficient LED lighting	$1	$20	0.48	24.7	4.2
17	Lighting - Power Retrofit: Dryer Plenum Lights	Replace with new energy-efficient LED lighting	$2	$60	0.46	25.8	12.2
	TOTAL, all measures		**$5,703 + $200 Maint. Savings**	**$14,400**	**5.62**	**2.4**	**27,038.2**

Table Notes:

[1] Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

[2] Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $5,698 per year, or 15.3% of the buildings' total energy costs. These measures are estimated to cost $14,400, for an overall simple payback period of 2.4 years.

Table 1.4 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.4: Detailed Breakdown of Energy Costs in the Building

Annual Energy Cost Estimate							
Description	**Space Heating**	**Water Heating**	**Ventilation Fans**	**Clothes Drying**	**Lighting**	**Other Electrical**	**Total Cost**
Existing Building	$7,361	$3,408	$1,800	$12,778	$3,103	$8,837	**$37,288**
With Proposed Retrofits	$5,654	$3,148	$1,565	$10,195	$2,190	$8,837	**$31,589**
Savings	$1,707	$260	$235	$2,583	$913	$0	**$5,698**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Kwigillingok Washeteria. The scope of this project included evaluating building shell, lighting and other electrical systems, and HVAC equipment, motors and pumps. Measures were analyzed based on life-cycle-cost techniques, which include the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate of 3.0%/year in excess of general inflation.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to inventory the following to gain an understanding of how each building operates:

- Building envelope (roof, windows, etc.)
- Heating and ventilation equipment
- Lighting systems and controls
- Building-specific equipment

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Kwigillingok Washeteria enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis involves distinguishing the different fuels used on site, and analyzing their consumption in different activity areas of the building.

Kwigillingok Washeteria is classified as being made up of the following activity areas:

1) Washeteria: 1,645 square feet

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model of energy used. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) = **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money’s ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year’s savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated initial costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers.

2.4 Limitations of Study

All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. KWIGILLINGOK WASHETERIA

3.1. Building Description

The 1,645 square foot Kwigillingok Washeteria was constructed in 2010, with a normal occupancy of 4 people. The number of hours of operation for this building average 7.7 hours per day, considering all seven days of the week. The Kwigillingok Washeteria offers laundromat and shower services to the village.

The washeteria has four boilers that deliver heat to a hydronic heating system. The hydronic system provides space heating for the building, heats water for the five washers and two showers and supplies heat to the four dryers. Extending the heat recovery system from the power plant to the washeteria could help to meet the building’s year round demand for heat and reduce fuel consumption in the boilers by an estimated 3000 gallons per year on top of proposed retrofit savings.

An air handling system serves to regulate the moisture level in the washeteria. Air vents regulate the temperature in the boiler room and the dryer plenum.

Figure 1: Washing machines in Kwigillingok Washeteria

<u>Description of Building Shell</u>

The exterior walls of the washeteria are constructed with single stud 2x6 lumber construction with a 16-inch offset. The walls have approximately 5.5 inches polyurethane panel insulation in good condition. There is approximately 1,885 square feet of wall space in the WTP.

The washeteria has a cathedral ceiling with 2x6 lumber construction. The roof has standard framing and a 24-inch offset. The ceiling has approximately 5.5 inches of insulated polyurethane panels in good condition. There is approximately 1,734 square feet of roof space in the building.

The washeteria is built on pilings with the floor constructed of 2x10 joists with a 16-inch offset. The floor is insulated with about 5.5 inch polyurethane panels in good condition. There is approximately 1,645 square feet of floor space in the building.

The heated portion of the building has six total windows, each of which has triple-pane glass and measurements of approximately 4’ x 3’. There are two South facing windows, one in the office and one in the storage room, three East facing windows in the main laundry room and one North facing window in the boiler room.

There are insulated metal doors on the front (South) and back (North) side of washeteria. The doors are fairly well sealed. The front entrance door measures 3’ x 6’8” and has an arctic entry. The back door is a single door measuring 3’ x 6’8”.

<u>Description of Heating Plants</u>

The Heating Plants used in the building are:

Boiler 1

Nameplate Information:	Burnham Model # MP0231-GB2S
Fuel Type:	#1 Oil
Input Rating:	177,000 BTU/hr
Steady State Efficiency:	72 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Fire Rate:	1.65 gallons/hour

Boiler 2

Nameplate Information:	Burnham Model # MP0231-GB2S
Fuel Type:	#1 Oil
Input Rating:	177,000 BTU/hr
Steady State Efficiency:	72 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Fire Rate:	1.65 gallons/hour

Boiler 3

Nameplate Information:	Burnham Model # MP0231-GB2S
Fuel Type:	#1 Oil
Input Rating:	177,000 BTU/hr
Steady State Efficiency:	72 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Fire Rate:	1.65 gallons/hour

Boiler 4

Nameplate Information:	Burnham Model # MP0231-GB2S
Fuel Type:	#1 Oil
Input Rating:	177,000 BTU/hr
Steady State Efficiency:	72 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year
Fire Rate:	1.65 gallons/hour

All of the heat required for space heating, generating hot water for washers and showers and drying clothes in the washeteria is provided by four Burnham boilers. At the time of the energy audit, boiler #3 was out of commission due to expansion issues. Each boiler has its own circulating pump to circulate glycol through.

Figure 2: Existing fuel oil boilers.

Space Heating Distribution System

The majority of the space heating in the washeteria is provided by fin type baseboard heaters. There is one unit heater in the boiler room with a rating of 4.2 MBH.

Domestic Hot Water System

All water for the washeteria is heated by a 119 gallon hydronic hot water maker with an 8 gallon/minute continuous rating with a 70 degree F temperature rise.

Heat Recovery Information

The washeteria does not currently receive recovered heat. A heat recovery system currently brings recovered heat from the power plant to the water treatment plants to meet the majority of the water heating demand at that building. There is more recovered heat available than what the water treatment plant demands, especially during summer months when there is no need to heat anything other than water for the bathroom sink. The washeteria, however, demonstrates a fairly consistent demand for heat year round for washers, dryers and showers making it a logical destination for recovered heat.

The heat recovery system could be expanded to reach the washeteria. This would require an investment of approximately $200,000 and would allow the washeteria to reduce fuel consumption by an additional 3000 gallons per year (about $14,000/year) on top of the fuel savings associated with other recommended retrofits, bringing the total fuel consumption of the washeteria to less than 800 gallons/year.

Description of Building Ventilation System

The building ventilation system consists of three main components:

- An air handling unit meant to control moisture levels in the washeteria when it's occupied.
- A cooling fan meant to keep temperatures in the boiler room from exceeding 85 degrees F.
- A dryer plenum make-up air unit that runs when the dryers are operating.

Lighting

There are a total of 30 light fixtures containing 92 bulbs in the washeteria. The majority of fixtures contain 4' T8 fluorescent bulbs. Table 3.1 shows a breakdown of lighting by bulb type.

Table 3.1: Breakdown of Lighting by Bulb Type

Type of bulb	Total Number of Bulbs	Location(s)
4' T8 fluorescent	80	Boiler room, dryer plenum, main room, front office, storage room, bathrooms, entry
2' T8 fluorescent	10	Mop room, bathrooms
70 W high pressure sodium	2	Exterior

Lighting in the in the washeteria consumes approximately 4631.9 kWh annually constituting about 19% of the building's electrical consumption.

Plug Loads

The washeteria has a variety of electronics including a TV, radio, microwave and some other miscellaneous loads that require a plug into an electrical outlet. The use of these items consumes about 526 kWh annually.

Major Equipment

Table 3.2 contains the details on each of the major mechanical components found in the washeteria.

Table 3.2: Major Equipment List

Major Pumps + Motors	Purpose	Motor Size	Operating Schedule	Annual Energy Consumption (kWh)
Water Heater Circulating Pump	Circulating heated glycol through hot water maker	0.2 HP	~ 75% of washeteria operating hours	371
Building Heat Circulating Pump	Circulate heated glycol through unit heater and baseboards	0.85 HP	Always on Oct-May	3,225
Dryer Circulating Pump	Circulate heated glycol through hydronic dryers	0.89 HP	~ 7 hours per day, 6 days/week	1,416
Fuel Pump	Supply fuel to boilers	0.35 HP	~ 85% of the time washeteria is demanding heat.	1,413
Small Washing Machine x 3	Washing clothes	1.06 HP	~ 50% of washeteria operating hours	3,347
Medium Washing Machine	Washing clothes	1.17 HP	~ 50% of washeteria operating hours	1,230
Large Washing Machine	Washing clothes	1.34 HP	~ 50% of washeteria operating hours	2,812
Lift Station Effluent Pump	Pump washeteria and clinic effluent to wastewater lagoon	2.28 HP	~ half an hour per day	266
Hydronic Dryer x 4	Drying clothes	2 x .25 HP	~ 7 hours per day, 6 days/week	818

Figure 3: Hydronic Dryers in Kwigillingok Washeteria.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour. One KW of electric demand is equivalent to 1,000 watts running at a particular moment.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of #1 Fuel Oil provides approximately 132,000 BTUs of energy.

The Kwig Power Company (KPC) is the electric utility and runs the power plant in the Native Village of Kwigillingok. The utility provides electricity to the residents of Kwigillingok as well as all commercial and public facilities.

The average cost for each type of fuel used in this building is shown below in Table 3.3. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.3: Energy Rates by Fuel Type in Kwigillingok

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.6700/kWh
#1 Oil	$ 4.65/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, the Native Village of Kwigillingok pays approximately $37,288 annually for electricity and other fuel costs for the Kwigillingok Washeteria.

Figure 4 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the "Retrofit" bar in the figure to the "Existing" bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

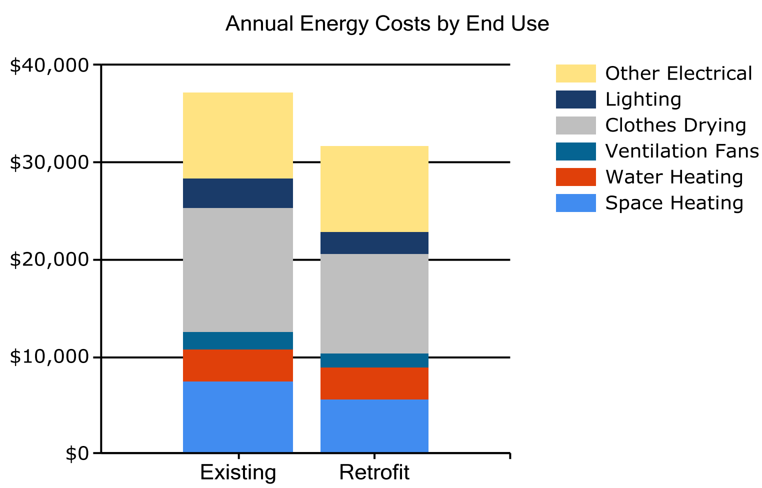

Figure 4: Annual Energy Costs by End Use.

Figure 5 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

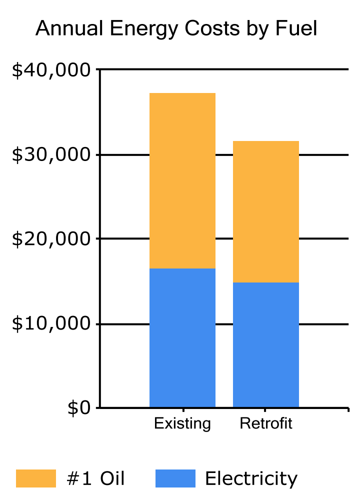

Figure 5: Annual Energy Costs by Fuel Type.

Figure 6 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

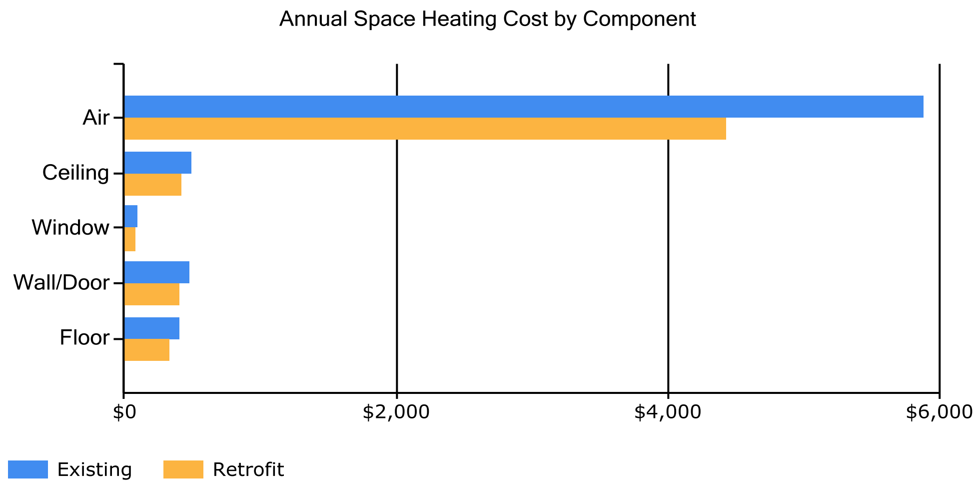

Figure 6: Annual Space Heating Cost by Component.

The tables below show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Table 3.4: Electrical Consumption Records by Category

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	147	131	124	82	46	22	0	0	37	73	104	148
DHW	15	14	15	15	15	15	15	15	15	15	15	15
Ventilation Fans	228	208	228	221	228	221	228	228	221	228	221	228
Clothes Drying	244	222	244	236	244	236	244	244	236	244	236	244
Lighting	433	395	433	419	338	327	338	338	327	433	419	433
Other Electrical	1355	1235	1355	1311	793	767	793	793	767	1355	1311	1355

Table 3.5: Fuel Oil Consumption Records by Category

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	242	216	202	130	65	21	0	0	48	113	169	243
DHW	58	53	58	57	61	60	63	63	59	60	57	58
Clothes Drying	191	174	193	190	201	199	208	208	196	197	188	191

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.6 for details):

$$\text{Building Site EUI} = \frac{\text{(Electric Usage in kBtu + Fuel Usage in kBtu)}}{\text{Building Square Footage}}$$

$$\text{Building Source EUI} = \frac{\text{(Electric Usage in kBtu X SS Ratio + Fuel Usage in kBtu X SS Ratio)}}{\text{Building Square Footage}}$$

where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.6: Kwigillingok Washeteria EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	24,469 kWh	83,514	3.340	278,936
#1 Oil	4,493 gallons	593,094	1.010	599,025
Total		**676,608**		**877,961**
BUILDING AREA		1,645	Square Feet	
BUILDING SITE EUI		411	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		534	**kBTU/Ft²/Yr**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

Table 3.7: Kwigillingok Washeteria Building Benchmarks

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	**411.3**	**31.66**	**$22.67**
With Proposed Retrofits	**336.6**	**25.91**	**$19.20**
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. **EUI/HDD: Energy Use Intensity per Heating Degree Day.** **ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.**			

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC system and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Kwigillingok Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Kwigillingok was used for analysis. From this, the model was be calibrated to predict the impact of theoretical energy savings measures. Once annual energy savings from a particular measure were predicted and the initial capital cost was estimated, payback scenarios were approximated.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Kwigillingok. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
• The heating load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in heating loads across different parts of the building.

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail.

Table 4.1: Energy Efficiency Measures

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
1	Setback Thermostat: Washeteria	Implement a heating setback of 60 deg F in the Washeteria during unoccupied hours.	$1,353	$200	90.74	0.1	6,226.1
2	Ventilation	Clean dryer lint traps regularly so that dryers don't have to run as long and plenum vent doesn't have to run as often.	$777	$500	20.04	0.6	3,724.0
3	Lighting - Power Retrofit: Front Office Lights	Replace with new energy-efficient LED lighting.	$124	$160	9.06	1.3	646.3
4	Lighting - Power Retrofit: Main Room Lights	Replace with new energy-efficient LED lighting.	$494	$640	9.06	1.3	2,585.0
5	Generic Clothes Drying Load	Replace broken solenoid valves with Belimo valves to improve dryer efficiency and reduce electrical consumption and run time.	$1,533	$3,000	6.73	2.0	7,194.7
6	Lighting - Power Retrofit: Entryway Light	Replace with new energy-efficient LED lighting.	$23	$60	4.53	2.6	121.5
7	Heating Ventilation, and Domestic Hot Water (DHW)	Clean boilers, replace hi-lo limits controllers, install larger expansion tank to address boiler #3 expansion issues, reprogram Tekmar boiler controller.	$1,039 + $200 Maint. Savings	$8,000	2.63	6.5	4,719.3
8	Lighting - Combined Retrofit: Boiler Room Lights	Replace with new energy-efficient LED lighting, replace manual switching with occupancy sensor.	$205	$980	2.46	4.8	1,071.2
9	Lighting - Power Retrofit: Bathroom 1 Light 1	Replace with new energy-efficient LED lighting.	$4	$20	2.39	4.9	21.4

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]	CO_2 Savings
10	Lighting - Power Retrofit: Bathroom 1 Light 2	Replace with new energy-efficient LED lighting	$8	$40	2.39	4.9	42.7
11	Lighting - Power Retrofit: Bathroom 2 Light 2	Replace with new energy-efficient LED lighting	$4	$20	2.39	4.9	21.4
12	Lighting - Power Retrofit: Bathroom 2 Light 1	Replace with new energy-efficient LED lighting	$8	$40	2.39	4.9	42.7
13	Lighting - Power Retrofit: Bathroom 1 Light 3	Replace with new energy-efficient LED lighting	$8	$40	2.30	5.1	41.0
14	Lighting - Power Retrofit: Storage Room Lights	Replace with new energy-efficient LED lighting	$23	$120	2.22	5.2	120.3
15	Air Tightening	Perform air sealing to reduce air leakage by 5%.	$97	$500	1.78	5.2	444.2
16	Lighting - Power Retrofit: Mop Room Lights	Replace with new energy-efficient LED lighting	$1	$20	0.48	24.7	4.2
17	Lighting - Power Retrofit: Dryer Plenum Lights	Replace with new energy-efficient LED lighting	$2	$60	0.46	25.8	12.2
	TOTAL, all measures		**$5,703 + $200 Maint. Savings**	**$14,400**	**5.62**	**2.4**	**27,038.2**

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among the EEMs and does not "double count" savings.

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. When the building is in cooling mode, these items contribute to the overall cooling demands of the building; therefore, lighting efficiency improvements will reduce cooling requirements in air-conditioned buildings. Conversely, lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Air Sealing Measures

Rank	Location		Existing Air Leakage Level (cfm@50/75 Pa)		Recommended Air Leakage Reduction (cfm@50/75 Pa)	
15			Air Tightness estimated as: 2470 cfm at 50 Pascals		Perform air sealing to reduce air leakage by 5%.	
Installation Cost		$500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$97
Breakeven Cost		$891	**Savings-to-Investment Ratio**	1.8	**Simple Payback yrs**	5
Auditors Notes: Install weather stripping on doors to reduce air leakage.						

4.4 Mechanical Equipment Measures

4.4.1 Heating Measure

Rank	Recommendation					
7	Clean boilers, replace hi-lo limits controllers, install larger expansion tank to address boiler #3 expansion issues, reprogram Tekmar					
Installation Cost		$8,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$1,035
					Maintenance Savings (/yr)	$200
Breakeven Cost		$21,004	**Savings-to-Investment Ratio**	2.6	**Simple Payback yrs**	6
Auditors Notes: Install a larger expansion tank in line with boiler #3 to bring it back in commission and allow all boilers to experience more even wear. Clean the boilers to improve efficiency and reduce idle loss. Replace hi-lo limits controllers and reprogram Tekmar boiler controller to stage boilers and allow them to run cold more often, further reducing idle loss. Train operator in boiler maintenance.						

4.4.2 Ventilation System Measures

Rank	Description			Recommendation		
2				Clean dryer lint traps regularly so that dryers don't have to run as long, plenum vent doesn't have to run as often		
Installation Cost		$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$766
Breakeven Cost		$9,876	**Savings-to-Investment Ratio**	19.8	**Simple Payback yrs**	1
Auditors Notes: Clean the dryer lint traps and train the operator and washeteria employees in this routine maintenance procedure. Cleaning the lint traps will increase drying efficiency and reduce dryer run time. This will reduce electrical consumption of the dryers themselves and will also reduce the run time of the dryer plenum air make-up unit, which runs when dryers run. Less air exchange will also reduce heating demands.						

4.4.3 Night Setback Thermostat Measures

Rank	Building Space			Recommendation		
1	Washeteria			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.		
Installation Cost		$200	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,352
Breakeven Cost		$18,131	**Savings-to-Investment Ratio**	90.7	**Simple Payback yrs**	0
Auditors Notes: Program thermostat to implement a heating setback to 60 degrees F so that less fuel is consumed heating the washeteria when it is unoccupied.						

4.5 Electrical & Appliance Measures

4.5.1 Lighting Measures

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition	Recommendation
3	Front Office Lights	2 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$124
Breakeven Cost	$1,450	**Savings-to-Investment Ratio**	9.1	**Simple Payback yrs**	1

Auditors Notes: This room contains two fixtures with four bulbs each to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.

Rank	Location	Existing Condition	Recommendation
4	Main Room Lights	8 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$640	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$399
Breakeven Cost	$4,536	**Savings-to-Investment Ratio**	7.1	**Simple Payback yrs**	2

Auditors Notes: This room contains eight fixtures with four bulbs each to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.

Rank	Location	Existing Condition	Recommendation
6	Entryway Light	FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$60	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$23
Breakeven Cost	$272	**Savings-to-Investment Ratio**	4.5	**Simple Payback yrs**	3

Auditors Notes: This room contains one fixture with three bulbs to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.

Rank	Location		Existing Condition		Recommendation	
8	Boiler Room Lights		6 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient LED lighting and add new occupancy sensor.	
Installation Cost	$980	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$205	
Breakeven Cost	$2,407	**Savings-to-Investment Ratio**	2.5	**Simple Payback yrs**	5	
Auditors Notes: This room contains six fixtures with four bulbs each to be replaced with LEDs. Add an occupancy sensor to ensure that lights turn off when the room is unoccupied. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location		Existing Condition		Recommendation	
9	Bathroom 1 Light 2		2 FLUOR T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient LED lighting.	
Installation Cost	$40	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$8	
Breakeven Cost	$96	**Savings-to-Investment Ratio**	2.4	**Simple Payback yrs**	5	
Auditors Notes: This fixture actually contains four 2' T8 bulbs to be replaced with LEDS. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location		Existing Condition		Recommendation	
10	Bathroom 2 Light 1		2 FLUOR T8 4' F32T8 32W Standard Instant StdElectronic with Occupancy Sensor		Replace with new energy-efficient LED lighting.	
Installation Cost	$40	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$8	
Breakeven Cost	$96	**Savings-to-Investment Ratio**	2.4	**Simple Payback yrs**	5	
Auditors Notes: This fixture contains two 4' bulbs to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location		Existing Condition		Recommendation	
11	Bathroom 1 Light 1		FLUOR T8 4' F32T8 32W Standard Instant StdElectronic with Occupancy Sensor		Replace with new energy-efficient LED lighting.	
Installation Cost	$20	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$4	
Breakeven Cost	$48	**Savings-to-Investment Ratio**	2.4	**Simple Payback yrs**	5	
Auditors Notes: This fixture contains two 2' bulbs to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location		Existing Condition		Recommendation	
12	Bathroom 2 Light 2		FLUOR T8 4' F32T8 32W Standard Instant StdElectronic with Occupancy Sensor		Replace with new energy-efficient LED lighting.	
Installation Cost		$20	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$4
Breakeven Cost		$48	**Savings-to-Investment Ratio**	2.4	**Simple Payback yrs**	5
Auditors Notes: This fixture contains two 2’ bulbs to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location		Existing Condition		Recommendation	
13	Bathroom 1 Light 3		FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Occupancy Sensor		Replace with new energy-efficient LED lighting.	
Installation Cost		$40	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$8
Breakeven Cost		$92	**Savings-to-Investment Ratio**	2.3	**Simple Payback yrs**	5
Auditors Notes: This fixture contains two 4’ bulbs to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location		Existing Condition		Recommendation	
14	Storage Room Lights		2 FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic with Occupancy Sensor		Replace with new energy-efficient LED lighting.	
Installation Cost		$120	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$23
Breakeven Cost		$267	**Savings-to-Investment Ratio**	2.2	**Simple Payback yrs**	5
Auditors Notes: This room contains two fixtures with three bulbs each to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location		Existing Condition		Recommendation	
16	Mop Room Lights		FLUOR T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient LED lighting.	
Installation Cost		$20	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1
Breakeven Cost		$10	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	25
Auditors Notes: This fixture contains two 2’ bulbs to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.						

Rank	Location	Existing Condition		Recommendation	
17	Dryer Plenum Lights	FLUOR (3) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient LED lighting.	
Installation Cost	$60	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$2
Breakeven Cost	$27	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	26
Auditors Notes: This room contains one fixture with three bulbs to be replaced with LEDs. LEDs use less energy and last longer allowing for less frequent bulb replacement.					

4.5.2 Other Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
5		Clothes Dryers		Replace broken solenoid valves with Belimo valves to reduce electrical consumption and run time.	
Installation Cost	$3,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,639
Breakeven Cost	$21,589	**Savings-to-Investment Ratio**	7.2	**Simple Payback yrs**	2
Auditors Notes: The current solenoid valves are meant to operate in conjunction with customers depositing coins in the dryers and the associated timers. The solenoid valves aren’t currently closing properly so dryers run longer than necessary. Replace the solenoid with Belimo valves to ensure that dryers only run when needed to minimize electrical consumption by reducing run time. Cleaning the lint traps, as mentioned in the ventilation retrofit, will improve drying efficiency, further reducing electrical consumption and run time.					

5. ENERGY EFFICIENCY ACTION PLAN

Through inspection of the energy-using equipment on-site and discussions with site facilities personnel, this energy audit has identified several energy-saving measures. The measures will reduce the amount of fuel burned and electricity used at the site. The projects will not degrade the performance of the building and, in some cases, will improve it.

Several types of EEMs can be implemented immediately by building staff, and others will require various amounts of lead time for engineering and equipment acquisition. In some cases, there are logical advantages to implementing EEMs concurrently. For example, if the same electrical contractor is used to install both lighting equipment and motors, implementation of these measures should be scheduled to occur simultaneously.

ANTHC is currently working with the Native Village of Kwigillingok in an effort to realize the retrofits identified in this report through Rural Alaskan Village Grant (RAVG) program. ANTHC will continue to work with Kwigillingok to secure any additional funding necessary to implement the recommended energy efficiency measures.

APPENDICES

Appendix A – Scanned Energy Billing Data

1. Electricity Billing Data

Kwig Power Company
Kwigillingok, AK 99622

Statement

Date
8/16/2016

To:
Kwig IRA Council RE: New Laundromat P.O.Box 90 Kwigillingok, Ak 99622

Amount Due	Amount Enc.
-$3,629.77	

Date	Transaction	Amount	Balance
12/31/2014	Balance forward		458.50
01/12/2015	PMT #20577. ck # 26802	-458.50	0.00
01/31/2015	INV #E19944. Due 01/31/2015.	405.94	405.94
	--- Comm Facilities, 1,946 @ $0.61 = 1,187.06		
	--- WTP PCE, 1,946 @ $0.4014 = -781.12		
02/06/2015	PMT #20639. ck # 26905	-405.94	0.00
02/28/2015	INV #E20048. Due 02/28/2015.	549.29	549.29
	--- Comm Facilities, 2,045 @ $0.67 = 1,370.15		
	--- WTP PCE, 2,045 @ $0.4014 = -820.86		
03/09/2015	PMT #20701. ck # 27027	-549.29	0.00
03/31/2015	INV #E20156. Due 03/31/2015.	632.28	632.28
	--- Comm Facilities, 2,354 @ $0.67 = 1,577.18		
	--- WTP PCE, 2,354 @ $0.4014 = -944.90		
04/08/2015	PMT #20775. ck # 27133	-632.28	0.00
04/30/2015	INV #E20239. Due 04/30/2015.	601.66	601.66
	--- Comm Facilities, 2,240 @ $0.67 = 1,500.80		
	--- WTP PCE, 2,240 @ $0.4014 = -899.14		
05/11/2015	PMT #20861. ck # 27226	-601.66	0.00
05/31/2015	INV #E20376. Due 05/31/2015.	587.97	587.97
	--- Comm Facilities, 2,189 @ $0.67 = 1,466.63		
	--- WTP PCE, 2,189 @ $0.4014 = -878.66		
06/09/2015	PMT #20924. ck # 27351	-587.97	0.00
06/30/2015	INV #E20485. Due 06/30/2015.	445.88	445.88
	--- Comm Facilities, 1,660 @ $0.67 = 1,112.20		
	--- WTP PCE, 1,660 @ $0.4014 = -666.32		
07/31/2015	INV #E20595. Due 07/31/2015.	446.63	892.51
	--- Comm Facilities, 1,606 @ $0.67 = 1,076.02		
	--- WTP PCE, 1,606 @ $0.3919 = -629.39		
08/10/2015	PMT #21031. ck # 27564	-446.63	445.88
08/10/2015	CREDMEM #E20614.	-7,000.00	-6,554.12
	--- Comm Facilities $-7,000.00		
08/11/2015	PMT #21032. ck # 27571	-445.88	-7,000.00

CURRENT	1-30 DAYS PAST DUE	31-60 DAYS PAST DUE	61-90 DAYS PAST DUE	OVER 90 DAYS PAST DUE	Amount Due
-3,629.77	0.00	0.00	0.00	0.00	-$3,629.77

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Kwig Power Company
Kwigillingok, AK 99622

Statement

Date
8/16/2016

To:
Kwig IRA Council RE: New Laundromat P.O.Box 90 Kwigillingok, Ak 99622

Amount Due	Amount Enc.
-$3,629.77	

Date	Transaction	Amount	Balance
08/31/2015	INV #E20732. Due 08/31/2015. --- Comm Facilities, 1,748 @ $0.67 = 1,171.16 --- WTP PCE, 1,748 @ $0.3119 = -545.20	625.96	-6,374.04
09/30/2015	INV #E20851. Due 09/30/2015. --- Comm Facilities, 1,780 @ $0.67 = 1,192.60 --- WTP PCE, 1,780 @ $0.3119 = -555.18	637.42	-5,736.62
10/30/2015	INV #E21083. Due 10/30/2015. --- Comm Facilities, 2,304 @ $0.67 = 1,543.68 --- WTP PCE, 2,304 @ $0.3119 = -718.62	825.06	-4,911.56
11/30/2015	INV #E20969. Due 12/10/2015. --- Comm Facilities, 2,304 @ $0.67 = 1,543.68 --- WTP PCE, 2,304 @ $0.3119 = -718.62	825.06	-4,086.50
12/31/2015	INV #E21194. Due 12/31/2015. --- Comm Facilities, 1,493 @ $0.67 = 1,000.31 --- WTP PCE, 1,493 @ $0.3119 = -465.67	534.64	-3,551.86

CURRENT	1-30 DAYS PAST DUE	31-60 DAYS PAST DUE	61-90 DAYS PAST DUE	OVER 90 DAYS PAST DUE	Amount Due
-3,629.77	0.00	0.00	0.00	0.00	-$3,629.77

2. Fuel Billing Records (Washeteria and Water Treatment Plant are combined)

ACCOUNTS RECEIVABLE LEDGER

WTP / Laundry — ACCOUNT NO.

S/O Coming — SHEET NO.

DATE	INVOICE NUMBER / DESCRIPTION	CHARGES		CREDITS		BALANCE	
	BALANCE FORWARD					1450.	01
12.26.14	[illegible]	100.	00			1350.	01
1.19.15	[illegible]	100.	00			1250	01
1.20.15	[illegible]	200	00			1050	01
1.23.15	[illegible]	5.	0			1045	01
1.26.15	[illegible]	105	01			940.	00
1.31.15	[illegible]	100.	00			840	00
2.12.15	[illegible]	100.	00			740	00
2/25/15	[illegible]	100.	00			640.	00
2.26.15	[illegible]	100.	0			540	00
3.16.15	[illegible]	100	0			440	00
3.28.15	[illegible]	440.	0				ϕ
5.13.15	Pd			3814	.98		
5.13.15	[illegible]	120	15			3694	83
5.18.15	[illegible]	400	0			3294.	83
5.19.15	[illegible]	200	0			3094	83
8.1.15	[illegible]	200.	0			2894	83
8.3.15	[illegible]	200	0			2694	83
8.12.15	Credit PAID			2150	53	4845	36
9.15.15	[illegible]	300	01			4545	35

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B

ACCOUNTS RECEIVABLE LEDGER

WTP / Laundry

ACCOUNT NO.

SHEET NO.

S/O Coming

DATE	INVOICE NUMBER / DESCRIPTION	CHARGES		CREDITS	BALANCE	
	BALANCE FORWARD				4545.35	
10.16.15	John [illegible]	200.	00		4345	35
11.4.15	Jimmy Phillips	430	89		3914	46
11.5.15	Jimmy Phillips	575.	00		3339.	46
11.6.15	Jimmy Phillips	720	00		2619	46
12.9.15	[illegible]	10.	0		2609	46
1.4.16	J. Phillips	460.	13		2149.	33
1.5.16	J. Phillips	360.	03		1789.	93
2.16.16	J. Phillips	480.	15		1309.	78
4.25.16	J. Phillips	224	44		1085.	34
4.26.16	J. Phillips	360.	0		725.	34
4.28.16	J. Phillips	482	19		243	15
4.28.16	J. Phillips	243	15		-0-	

PRODUCT D83

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Appendix B – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Kwigillingok Washeteria	**Auditor Company:** Alaska Native Tribal Health Consortium
Address: Kwigillingok	**Auditor Name:** Kevin Ulrich & Bailey Gamble
City: Kwigillingok	**Auditor Address:** 4500 Diplomacy Drive, Suite 454 Anchorage, AK 99508
Client Name: John Carter	
Client Address:	**Auditor Phone:** (907) 729-3237
	Auditor FAX: (907) 729-3729
Client Phone: (907) 588-2022	**Auditor Comment:**
Client FAX:	
Design Data	
Building Area: 1,645 square feet	**Design Space Heating Load:** Design Loss at Space: 194,396 Btu/hour with Distribution Losses: 204,628 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 311,932 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 4 people	**Design Indoor Temperature:** 70 deg F (building average)
Actual City: Kwigillingok	**Design Outdoor Temperature:** -37.1 deg F
Weather/Fuel City: Kwigillingok	**Heating Degree Days:** 12,990 deg F-days
Utility Information	
Electric Utility: Kwig Power Company - Commercial - Lg	**Natural Gas Provider:** None
Average Annual Cost/kWh: $0.670/kWh	**Average Annual Cost/ccf:** $0.000/ccf

Annual Energy Cost Estimate

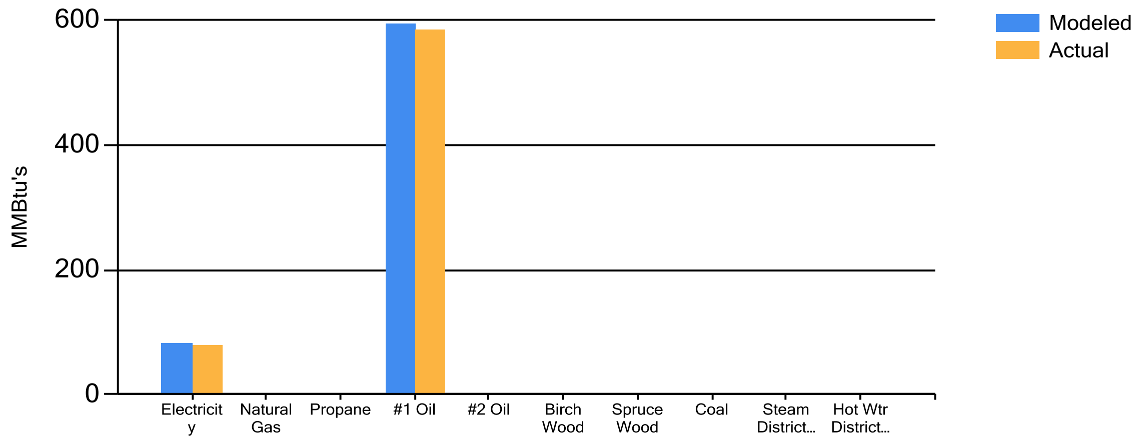
Description	Space Heating	Water Heating	Ventilation Fans	Clothes Drying	Lighting	Other Electrical	Total Cost
Existing Building	$7,361	$3,408	$1,800	$12,778	$3,103	$8,837	**$37,288**
With Proposed Retrofits	$5,654	$3,148	$1,565	$10,195	$2,190	$8,837	**$31,589**
Savings	$1,707	$260	$235	$2,583	$913	$0	**$5,698**

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	411.3	31.66	$22.67
With Proposed Retrofits	336.6	25.91	$19.20
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

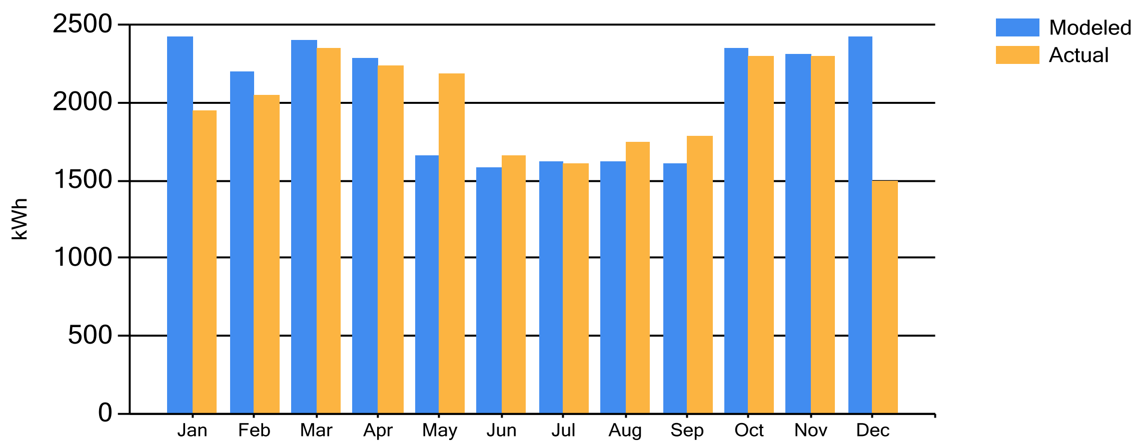
Appendix C – Actual Fuel Use versus Modeled Fuel Use

The graphs below show the modeled energy usage results of the energy audit process compared to the actual energy usage report data. The model was completed using AkWarm modeling software. The orange bars show actual fuel use, and the blue bars are AkWarm's prediction of fuel use.

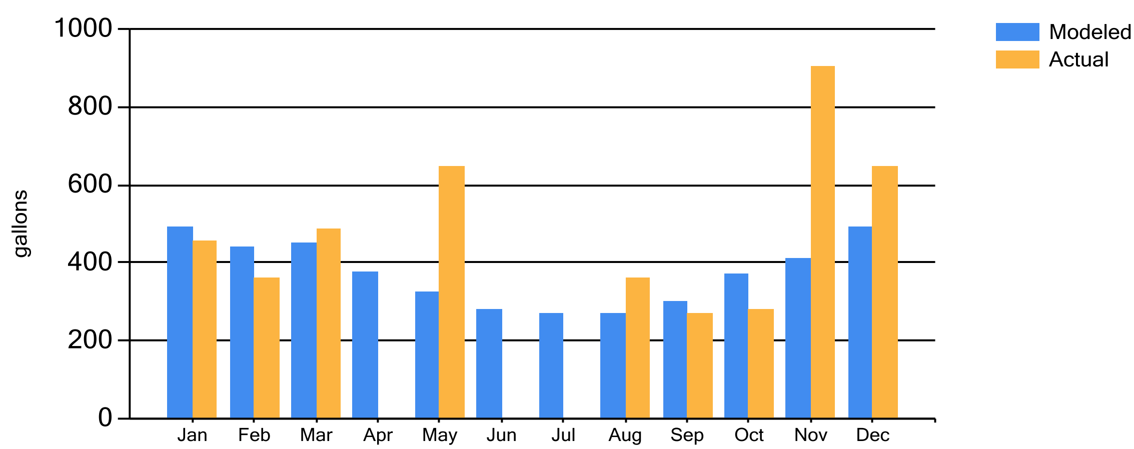
Annual Fuel Use



Electricity Fuel Use



#1 Fuel Oil Fuel Use



Appendix D - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	9.9	9.9	9.8	9.8	9.0	9.0	8.9	8.9	9.0	9.8	9.8	9.9
As Proposed	9.3	9.3	9.2	9.2	8.4	8.4	8.4	8.4	8.4	9.2	9.2	9.3

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